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INSTRUCTION BOOK AND INSTALLATION PROCEDURE  
FOR  
VHF KIT TO BE USED WITH CRYSTAL VIDEO RECEIVING SYSTEM  
MODEL 3502M

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FOR  
VHF KIT TO BE USED WITH CRYSTAL VIDEO RECEIVING SYSTEM  
MODEL 3502M

15 December, 1954

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Page i of iii preliminary pages.

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TABLE OF CONTENTS

	Page No.
LIST OF ILLUSTRATIONS	iii
SECTION 1 - GENERAL DESCRIPTION	1
SECTION 2 - ANTENNA AT-38/APT	7
SECTION 3 - VHF BAND-PASS FILTERS	9
SECTION 4 - INSTALLATION PROCEDURE	13

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INFORMATION

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INFORMATION

## LIST OF ILLUSTRATIONS

Fig. No.		Page No.
1	Block Diagram of Crystal Video Receiver Model 3502 M	2
2	Antenna-Filter System, Receiver Model 3502 M	3
3	Crystal Video System Schematic, Model 3502 M	5
4	Bottom View, Junction Box	6
5	Antenna AT-38A/APT	8
6	Schematic Diagram, VHF Band Pass Filter	10
7	Band Pass Characteristics, VHF Band Pass Filter	11
8	Top View, VHF Band Pass Filter	12
9	Suggested Antenna Locations	14
10	Antenna-Filter- Crystal Holder-Preamplifier Assembly for Crystal Video Receiver Model 3502 M	16

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SECURITY

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**SECTION 1 - GENERAL DESCRIPTION**

The crystal video receiving system model 3502 was originally designed to provide reception of radio signals between 700 and 10,000 mc. When the VHF kit described in these instructions is used with the model 3502 receiver its frequency coverage is extended to provide for reception of radio signals in the VHF band from 70 to 300 mc in addition to the original band. In order to distinguish between the original receiving system and the one which has been modified by incorporation of the VHF kit, the latter receiver will be designated as receiver model 3502M. (Where M stands for the VHF modification.)

The VHF kit used in the model 3502M receiver consists of five AT-38A/APT stub antennas, five VHF band-pass filters, five crystal holders and ten coaxial cables. Fig. 1 shows a block diagram of the complete installation.

The antenna-filter system used in the model 3502M receiver is shown in Fig. 2. This filter system is different from the original arrangement by the fact that the former channel A antenna and filter have been replaced by a stub antenna, type AT-38A/APT, and a VHF band-pass filter.

As a result of this modification the frequency bands shown at the bottom of Fig. 2 have been obtained. Note the difference between the frequency bands and the frequency channels. The frequency bands are coded in the following manner:

1. A signal between 4100 mc and 10,000 mc causes 4 cycles of a 100 cycle signal to be placed on the recording immediately following the signal.
2. A signal between 700 mc and 4100 mc cause 10 cycles of a 100 cycle signal to be placed on the recording immediately following the signal.

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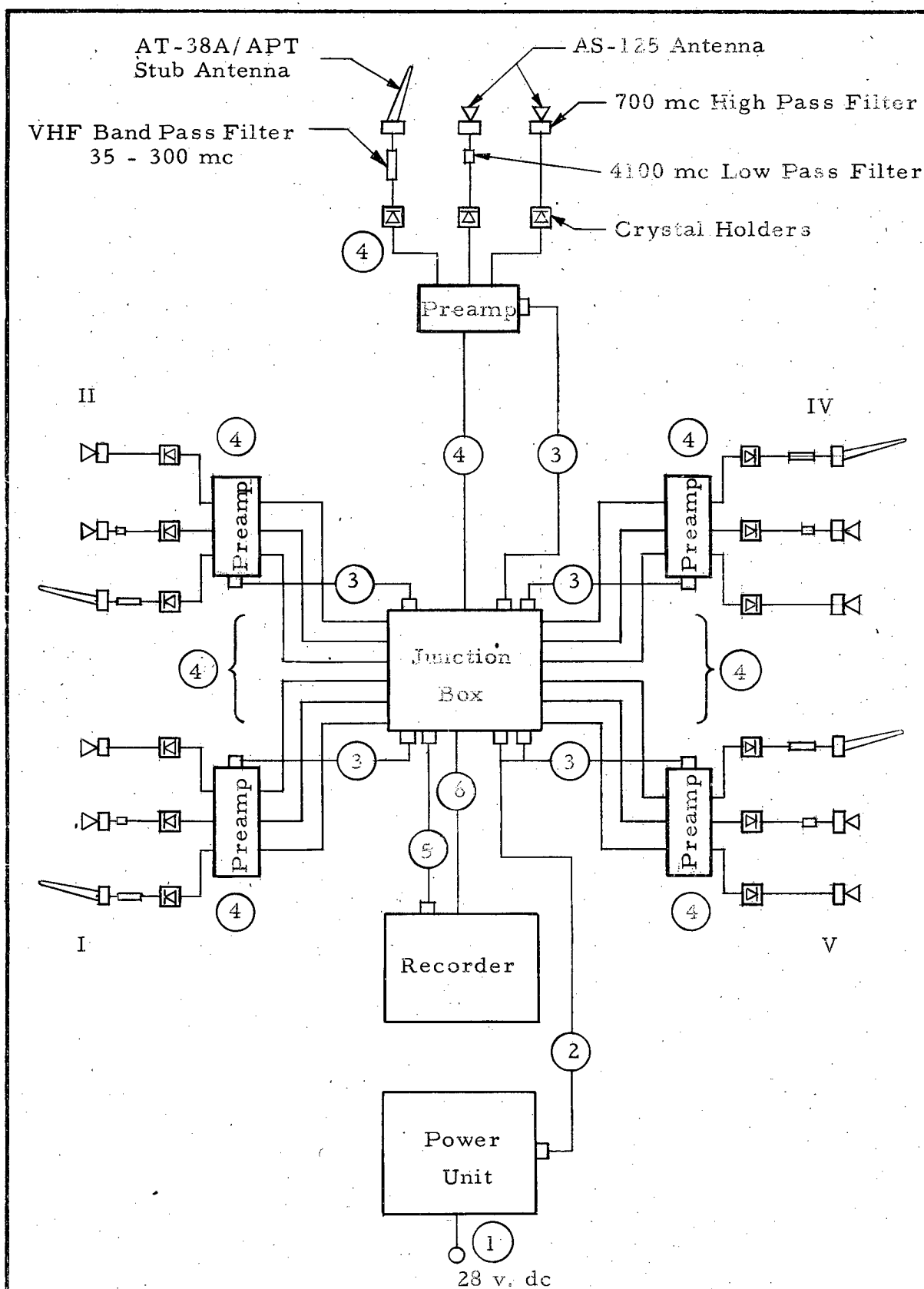


Fig. 1 - Block Diagram of Crystal Video Receiver, Model 3502 M.

-2-

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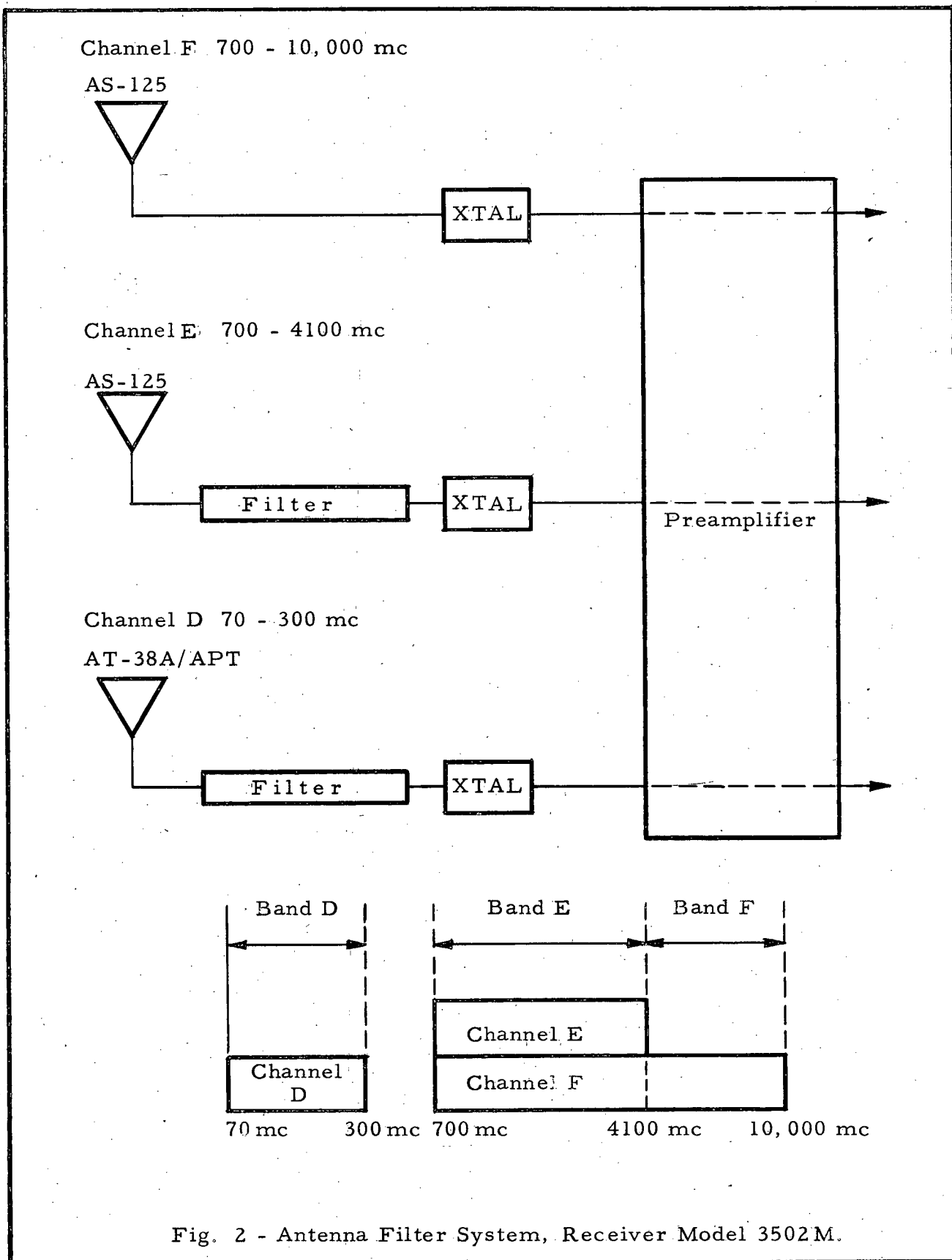
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3. A signal between 70 mc and 300 mc causes 20 cycles of a 100 cycle signal to be placed on the recording directly following the signal.

Channel E and Channel F for the model 3502M receiver are identical with Channels B and C respectively on the model 3502 receiver. Channel D on the modified system is obtained by means of an AT-38A/APT stub antenna and a 35 mc to 300 mc band-pass filter.

One modification is necessary in the junction box of a model 3502 receiver to insure that video signals from the VHF channel (Channel A) are still recorded when the system has been converted to a model 3502M receiver. Because all signal pulses for recording were formerly obtained through a single, wide-open channel (Channel C) in the model 3502 receiver, no VHF-video information would be recorded in the modified system since the AS-125 antenna for Channel C will not pass VHF frequencies because of the 700 mc high-pass filter in its base. In order to provide video signals for the VHF system, it is necessary to connect the output of V-16 in Channel A to the input of V-5 in the output channel. This connection is made very simply by connecting condenser C-401 (see red-penciled schematic diagram, Fig. 3, at the back of this instruction book) to the junction of R-402 and the 1N56 diode.

C-401 has already been installed in the junction box with the disconnected end wound in a small coil (see point "X" in Fig. 4). In order to distinguish C-401 from C-402 it will be necessary to check with an ohmmeter. C-401 has its soldered end connected to pin 6 of V-16, and a continuity check from pin 6 of V-16 to the soldered terminals of the two capacitors will indicate which is C-401.

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Fig. 3 is located on the inside back cover.

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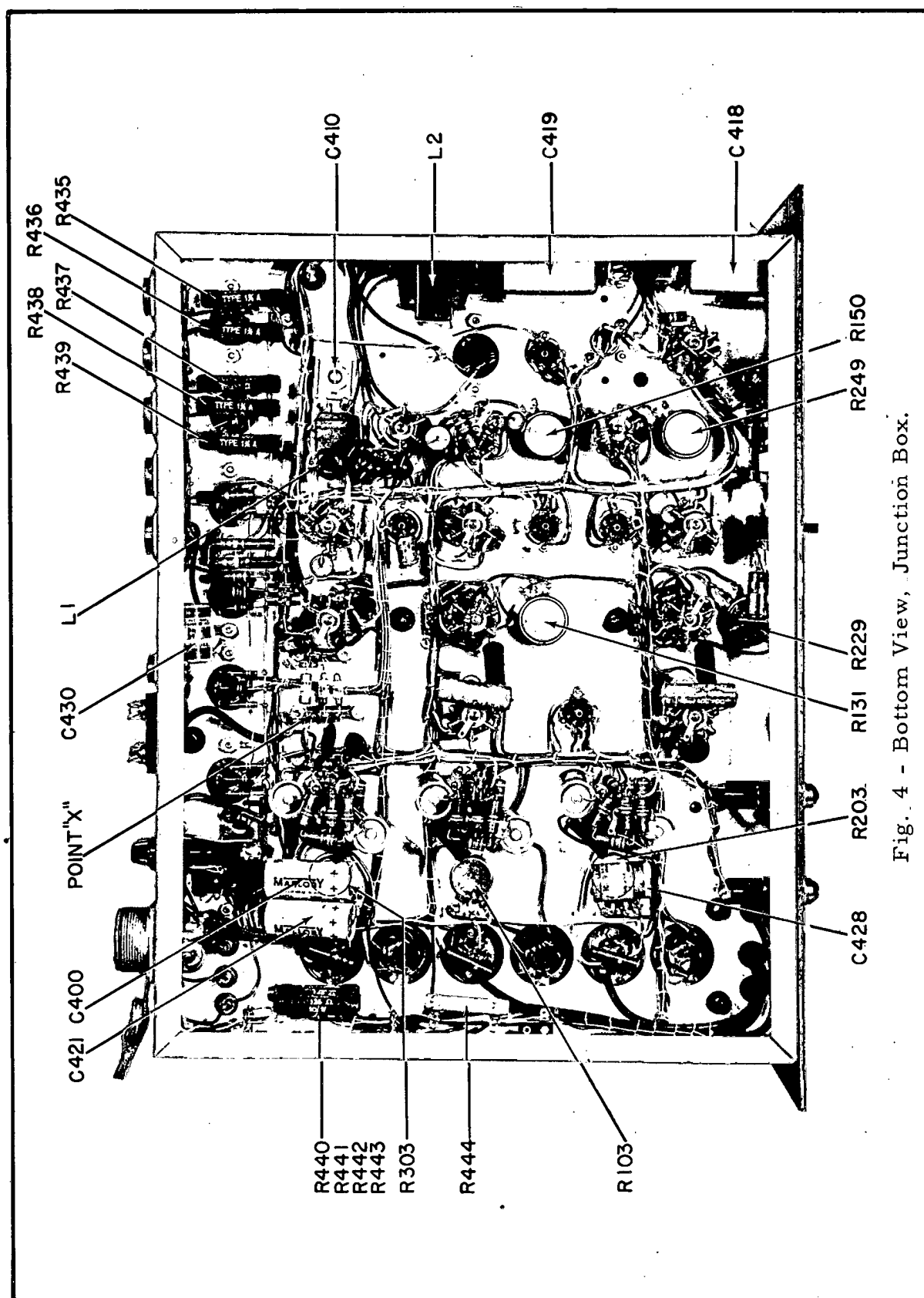
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-6-

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## SECTION 2 - ANTENNA AT-38A/APT

The AT-38A/APT stub antenna used with the model 3502M receiver is shown in Fig. 5. This antenna has a VSWR within 5:1 in the frequency range between 70 mc and 400 mc. It is designed to accept horizontal or vertical polarization or both depending on the position of mounting. The impedance of the antenna is approximately 50 ohms, unbalanced, and the output connector is a type "N" connector. The unit is 37 1/2 inches high including mast and mount and its total weight is 6 pounds.

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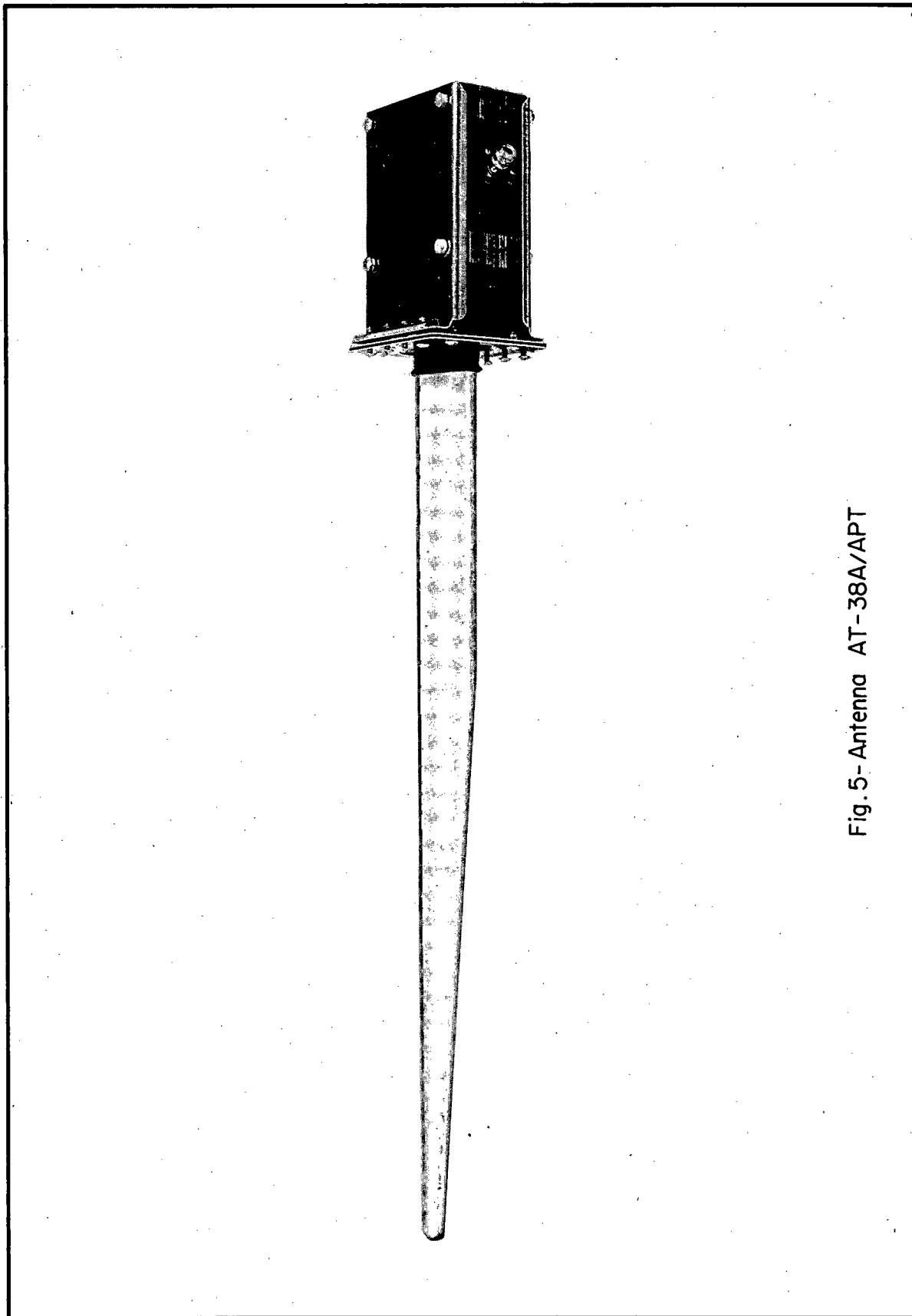


Fig. 5-Antenna AT-38A/APT

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### SECTION 3 - VHF BAND-PASS FILTERS

The VHF band-pass filters used with the model 3502M receiver pass a band of frequencies between 40 mc and 285 mc. The band-pass filter actually consists of two filters, a television type high pass filter, and a 300 mc low-pass filter consisting of a constant "k" midsection and two series "m" derived end sections (see Fig. 6). The input and output impedances of the composite filter are approximately 50 ohms and the frequency response as measured with a Hewlett-Packard model 608A signal generator, a IN21B crystal detector, and a Dumont 304A oscilloscope is flat  $\pm 3$  db (Fig. 7) between 40 mc and 285 mc. The insertion loss is approximately 3.5 db at midband.

The VHF band-pass filter is mounted in a 5 x 7 x 2 inch aluminum box as shown in Fig. 8. UG58/U type "N" connectors are used for terminations and either of these connectors may be used as the input connector. Note: Spurious responses at frequencies up to 500 mc have been tuned out of these filters by means of the ceramic trimmer condensers  $C_1$  and  $C_3$ . If these condensers are readjusted, for any reason, the filter response should again be checked at higher frequencies (up to 500 mc) to insure that spurious resonances have not been introduced. These filters should be installed with the cover plates on. If the high-pass filter coils (the exposed coils shown in Fig. 8) are bent or distorted, the filter response might change quite radically.

It is not necessary that the VHF band-pass filter be shock mounted since none of the components used are microphonic. It should, however, be secured to the deck of the aircraft since the crystal holder is attached to this unit and the microwave crystal is subject to breakage under severe shock.

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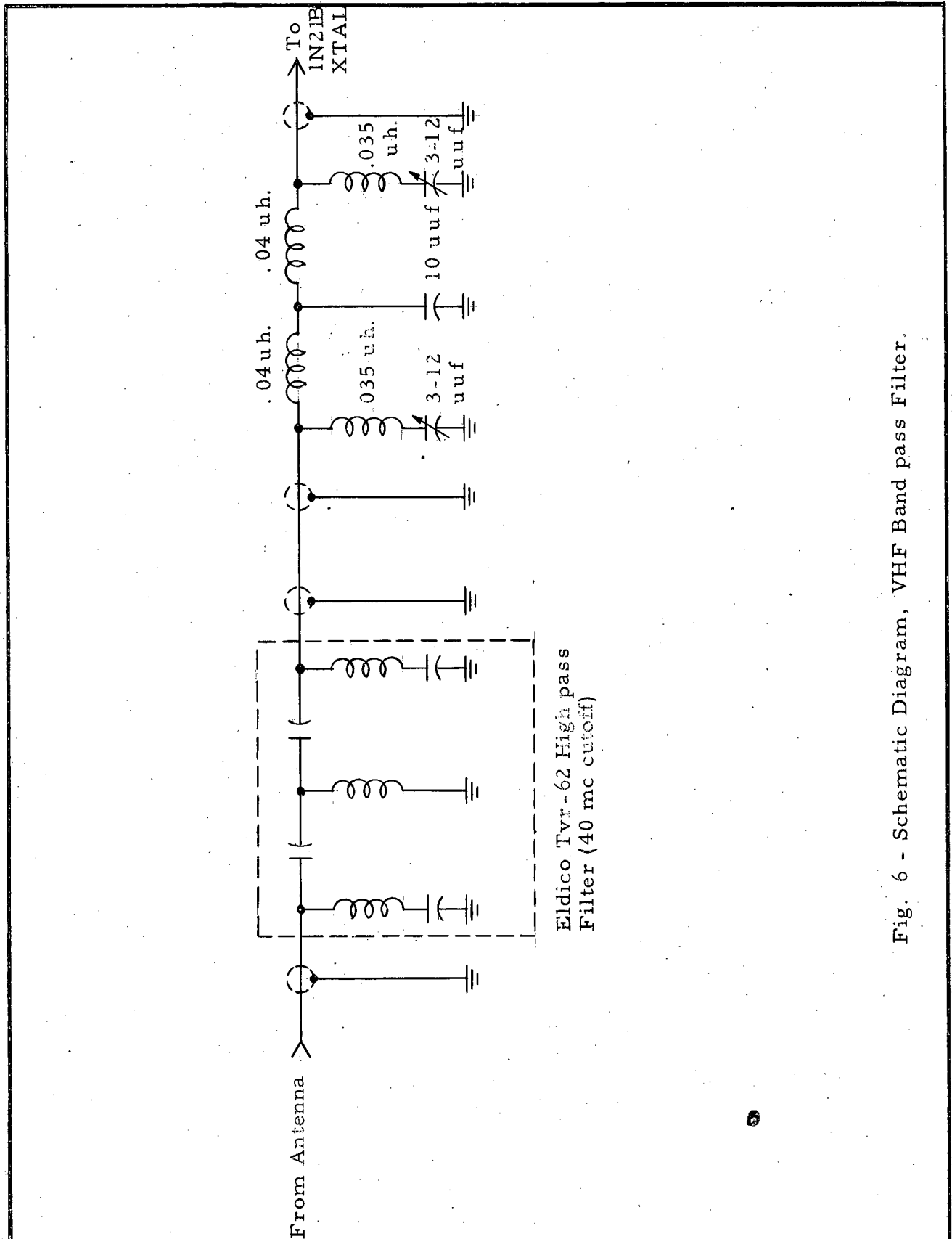


Fig. 6 - Schematic Diagram, VHF Band pass Filter.

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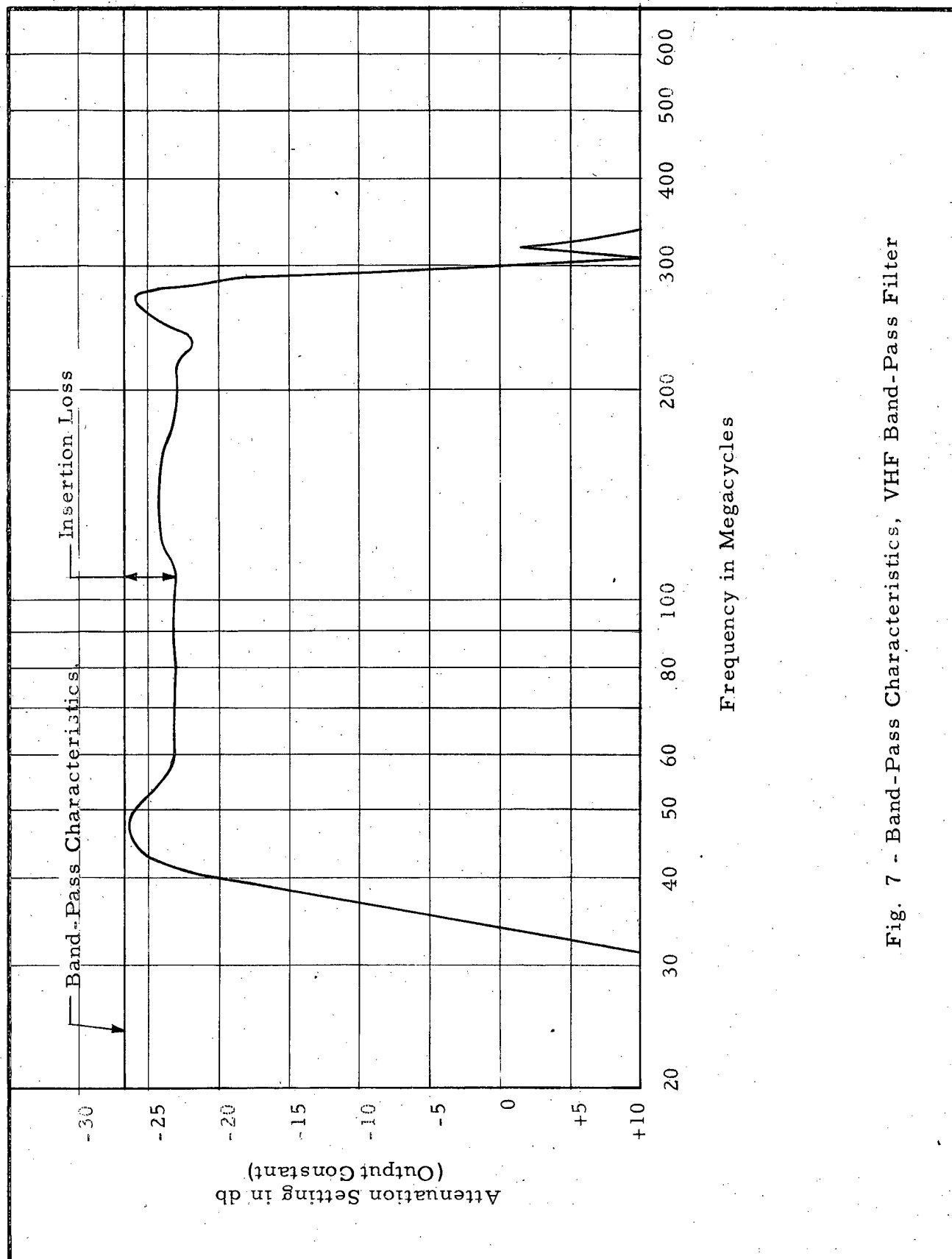


Fig. 7 - Band-Pass Characteristics, VHF Band-Pass Filter

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Fig. 8 - Top View, VHF Band - Pass Filter

-12-

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**SECTION 4 - INSTALLATION PROCEDURE**

The following steps should be followed in order to convert a model 3502 receiver installation into a model 3502M system.

1. Disconnect the input cable to Channel A on all five pre-amplifiers at positions I through V. (See Fig. 1).

2. Install stub antennas AT-38A/APT as close as possible to the original AS-125 antennas in groups I through V. The stub antenna should be mounted with its maximum diameter horizontal and the straight edge forward. Suggested antenna locations are shown in Fig. 9. It is not necessary for the stub to be level with the horizon. Care should be taken in cutting the mounting hole for this antenna so that the hole is large enough to prevent shorting of the copper foil (signal lead) to the fuselage.

If the AS-125 antennas on the original receiving system have been insulated from the fuselage it is advisable to modify the AT-38A/APT antenna so that no aircraft ground connection is made directly at the antenna by the UG58/U connector or the shield of the coaxial cable. In order to insulate these points the short cable and connector inside the antenna base may be removed from this base and reconnected to the signal foil by means of the center conductor. In order to insure that the stub antenna still has a ground plane, a 100 micromicrofarad mica condenser should be soldered between the shield of this short cable and the metal portion of the antenna mount. This condenser may be fastened with a ground lug and metal screw to the mounting frame. This cable with the UG58/U connector still intact can then be supported by bracketing it to the wooden portion of the antenna mount using wood screws. The "N" connector junction should then be wrapped with electrical tape so that it cannot be grounded if it comes in contact with the fuselage. Recent information on the operation of other crystal video systems has indicated that electrical insulation of the antennas is necessary in many cases.

3. Mount a VHF filter assembly near each preamplifier (within approximately one foot of each preamplifier). These filters should preferably be mounted flush with a wooden surface such as a

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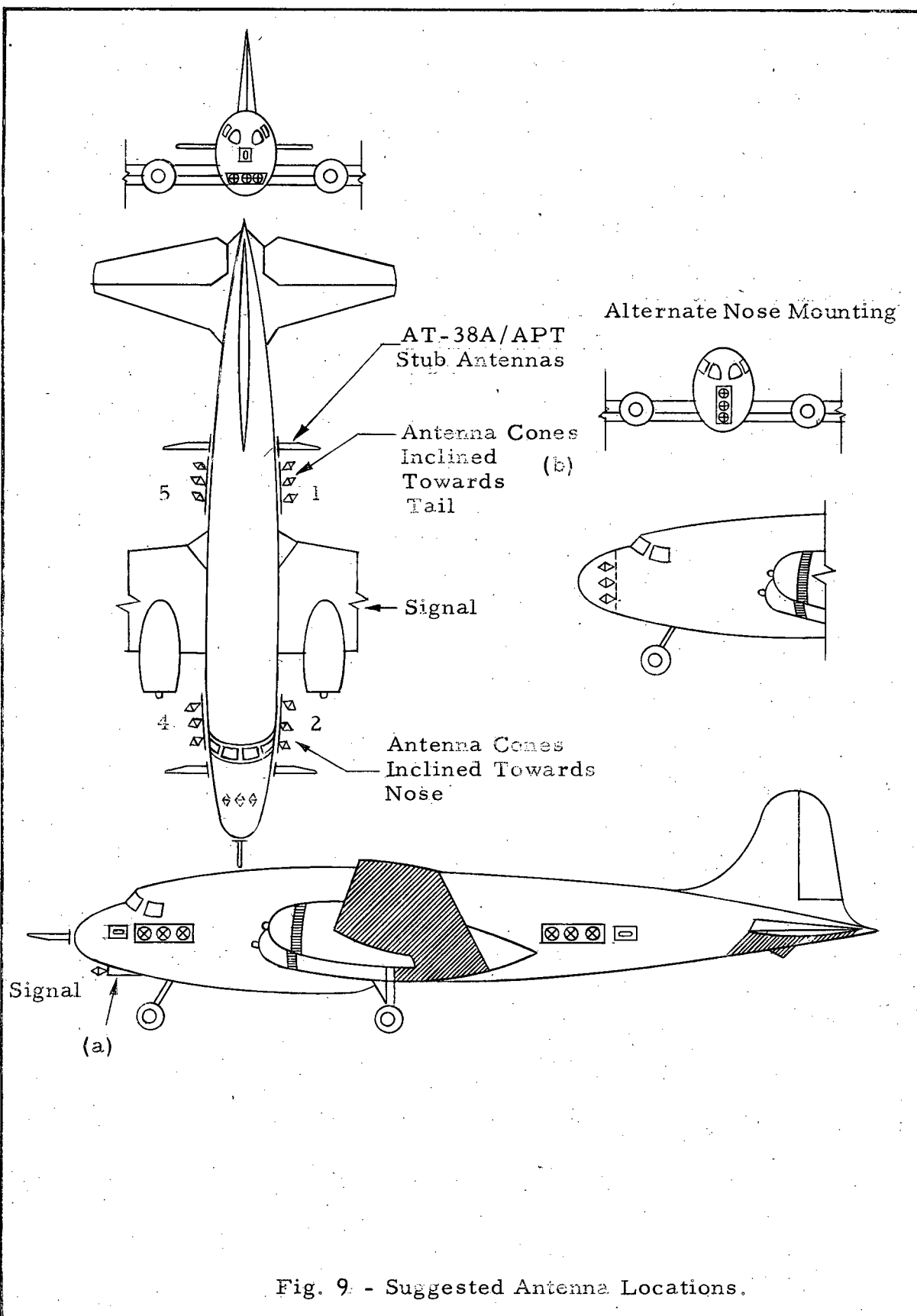


Fig. 9 - Suggested Antenna Locations.

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plywood deck and fastened with wood screws or bolts. If the VHF filter is mounted against metal, insulation of the antennas might be ineffective due to the ground produced at the VHF filter.

4. Connect a two-foot coaxial cable, type RG8/U, directly from each antenna terminal to each VHF filter. This is the thicker of the two types of cables supplied with the VHF kit. It is equipped with "N" connectors on each end.

5. Fasten the "N" connector side of a crystal holder to the opposite side of each VHF band-pass filter assembly. A IN32 video detector should be used in each of these crystal holders. This crystal has been selected because of its high figure of merit (greater than 100) and its high burnout rating (.36 watts).

6. Connect one of the narrower coaxial cables, type UG71/U, between the socket of the crystal holder and the Channel A input connector of each preamplifier.

The connections between the antenna and the preamplifier are illustrated in Fig. 10.

If only two or four instead of five stub antennas are used with this system the channel A input cables for the unused preamplifiers should be removed at the junction box and shorting type connections should be connected to these terminals. This will prevent excess noise from being introduced into the system through open input connectors.

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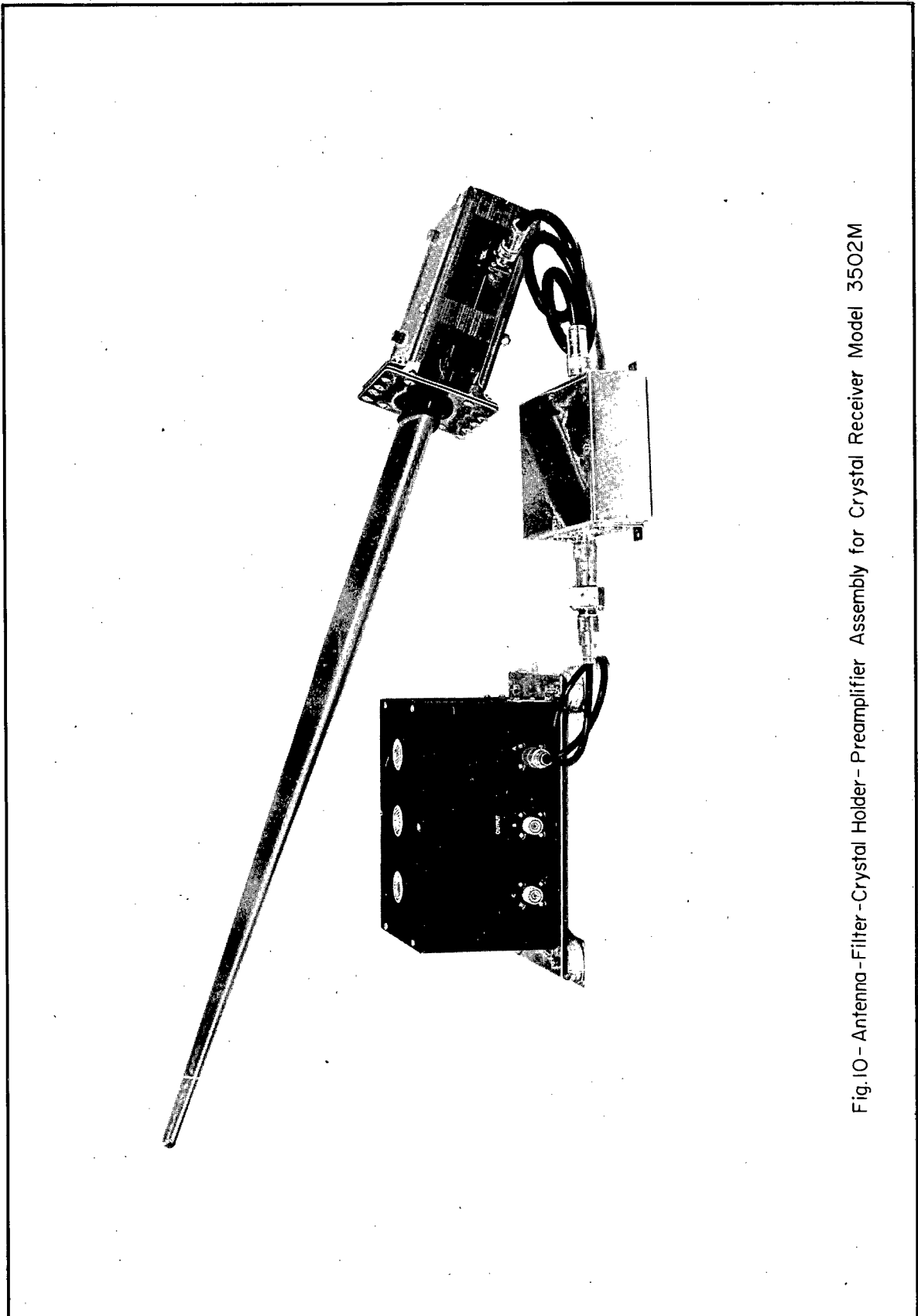


Fig. 10 - Antenna - Filter - Crystal Holder - Preamp - Amplifier Assembly for Crystal Receiver Model 3502M

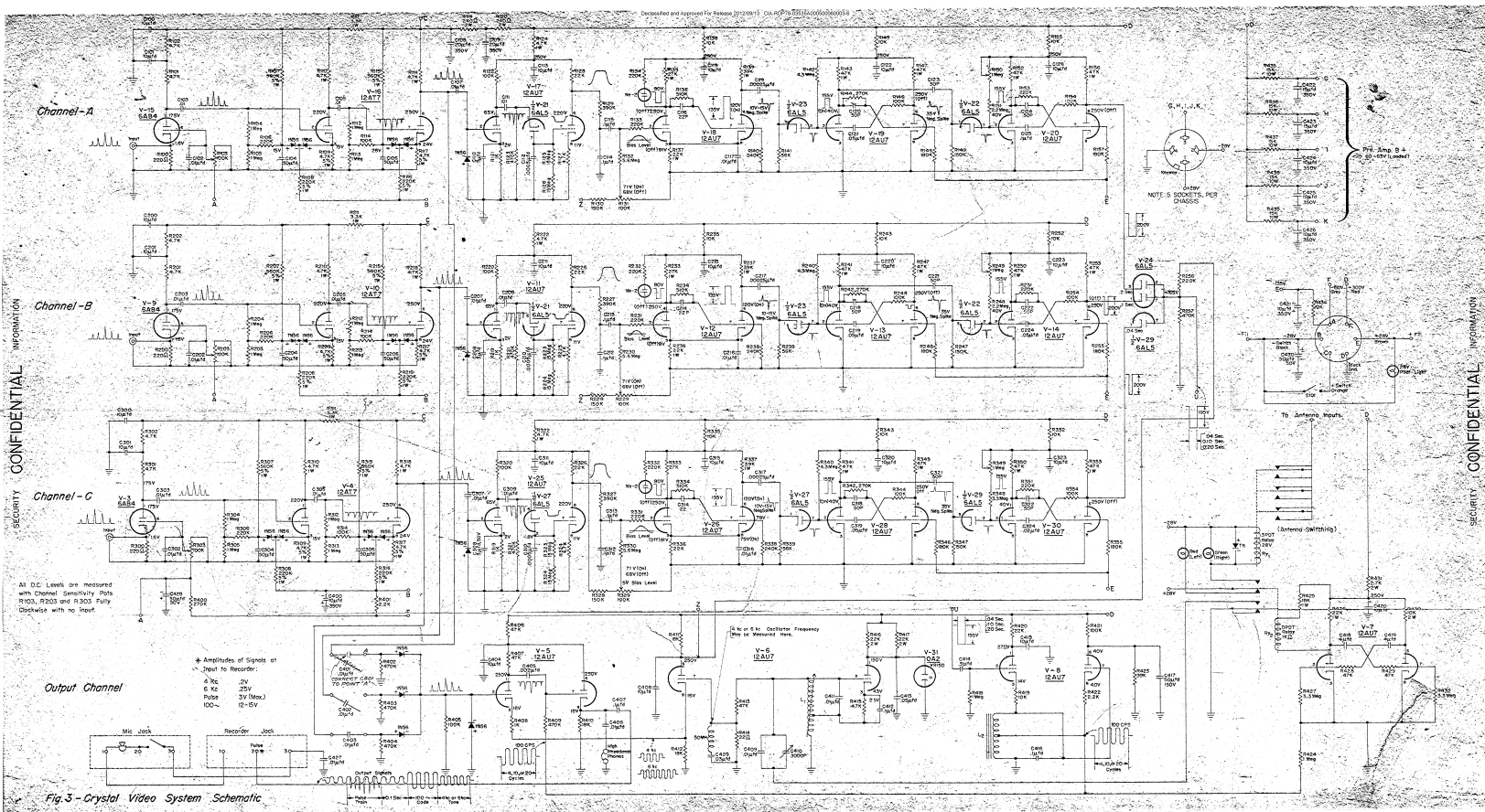
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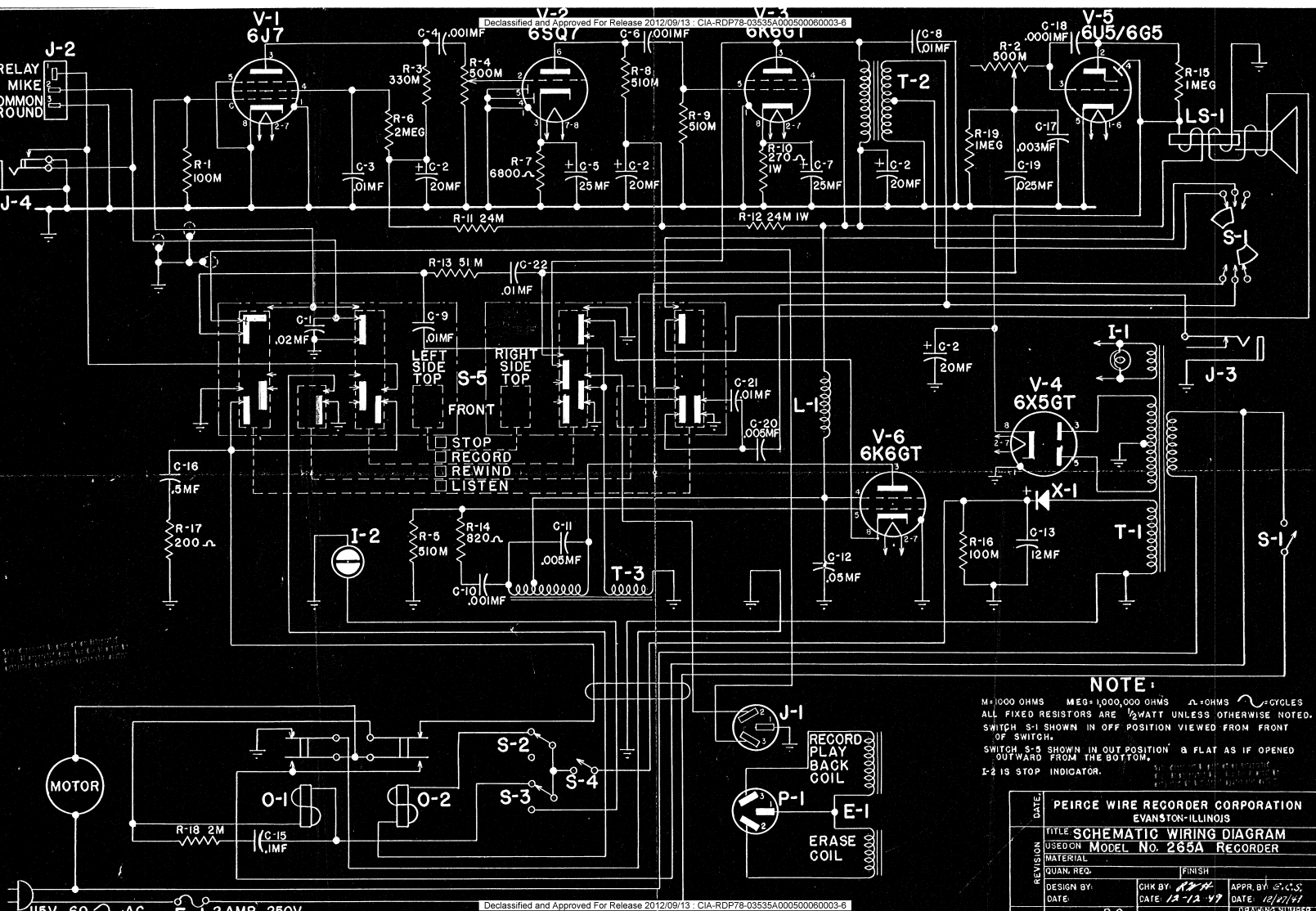
Fig. 3 - Crystal Video System Schematic

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*Fig. 9 - Crystal Video System Schematic*





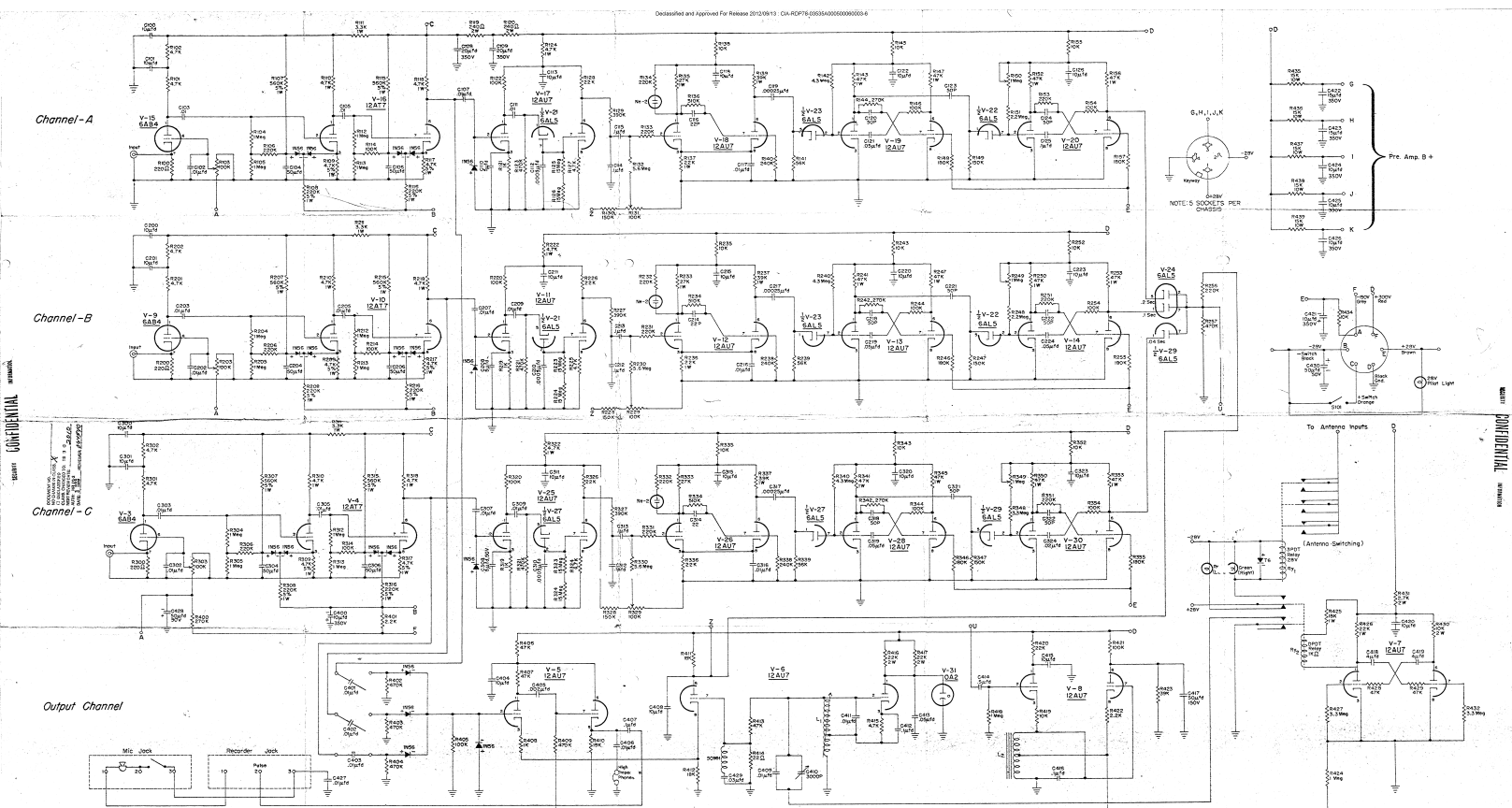




Fig. 9 - Crystal Video System Schematic

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112 181  
162  
24

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